CAMBER AND CROSS WEIGHT

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Over the last five or six years cross weight and camber have become more important and more common adjustments on karts. With cross, this increase in use of adjustment has stemmed primarily from an increased understanding that we can get a kart to run off the corner better if we better balance the work that the LR and RR share throughout that phase of the corner. With camber the increase has mostly been a result of chassis manufacturers developing karts which have stiffer front ends causing them to become more sensitive to the amount of camber being run. Add to this the conversion on most karts to heim joint front ends and much easier camber adjustment and we have a recipe for more frequent camber adjustments and many more discussions about how cross and camber affect each other. What we are going to do this month is to look at why we might change one as we change the other and to try to develop some general rules of thumb to help us know what to do with each as the other changes.

Getting through the turns fast requires a good balance of crossweight and camber

Before we get started we need to cover a couple of foundational issues. First, different karts tend to be designed to race with different standard cambers and different standard crossweights. This is a result from differences in the way the chassis are designed to move weight around as they load and unload. The result is that different karts will exhibit different sensitivities of camber to cross weight. The general trends should go in the same direction but on one kart a 5% cross change may tend to go with a 1/4° camber change whereas on another kart that same 5% cross change may tend to work best with a 1/8° camber change, etc. The point is not to define exactly how much to change camber based on a given cross change but rather to suggest what direction we'd expect that change to go. The next thing we need to discuss is that camber changes tend to be the result of cross changes rather than the other way around. This is to say that we don't typically change cross by several percent because we've decided to change the camber. Rather, we might change the cross by several percent and then make a change in camber to better work with the new range of crossweight. In fact, what happens most often is that the camber actually takes care of itself as we change the cross. What happens is that as we add cross using the front washers we naturally get more negative camber on the RF and more positive on the LF from the increased rake (the angle of the chassis between the

front wheels from side to side in relation to a horizon) in the chassis. The end result is that we change the loading on the tires with the crossweight and then change the camber to help the tires work better with the rest of the setup. The last thing we need to cover here is how large of a cross change we might expect to have to make before we need to consider a camber change along with it. You will notice that in our discussions we speak of cross changes as being several percent or changes in the range of cross in which we are running. If the change is only a percent or two, or even three or four, then it would be uncommon to make a camber change based solely on the change in cross. Within these smaller ranges of change, the cross and camber may be changed but we would not typically change the camber based simply on the fact that we made a cross change. This is the fine tuning range where we tend to change each variable individually without changing other things to try to extract the maximum performance out of our kart and these are also the types of changes we'd expect to be making on a week to week basis. What we are looking at as being a large enough cross change to begin to consider a change in camber based solely on the cross change will typically be in the range of five or six or more percent cross. Changes this large tend not to happen too often and most often result from going from two tracks with dramatically different bite characteristics or sizes.

Now that we've got some foundational concepts down, it's time to start looking at what direction things typically flow. As we have alluded to above, as we switch to running in a higher range of cross we will tend to see more negative camber in the right front and more positive camber in the left front. Likewise, if we change from the higher cross range to the lower then we would expect to see lower negative right front camber and lower positive left front camber. Why do we tend to see these changes? There are several reasons. Typically, as we add cross we will add bite to the RF. This change will affect the tire's grip characteristics all the way around the corner but it will tend to be most evident from turn-in up to the apex because this is the area where weight is transferring forward due to deceleration and to the right from the increasing cornering forces. At the same time, the added cross will tend to cause the LR to bite harder (because it is loaded more heavily). As with the RF, the change will affect the tire all the way through the corner but it will tend to be largest at corner exit when weight is transferring back to the LR as the kart exits the corner and cornering forces begin to decline. This additional LR bite center-off will tend to give the kart a larger tendency to become less responsive to steering input or to push in this part of the corner. If we look at it like this then we can see that more cross might tend to cause us to want to reduce the sensitivity of the RF at turn-in to help keep the kart from being loose or twitchy, and at the same time we may want to add some turning power to the kart from the center off to ensure that the kart will still turn as well as it needs to in order to be fast and allow it to navigate traffic effectively. We will begin our more detailed analysis by looking at the RF and once we've covered it then we will look at the LF.

The first place at which we will look to help us understand why we tend to run more negative RF camber with more cross is that higher cross weights tend to go with higher bite conditions. Under these types of conditions the steering can get a bit heavy; it may become overly sensitive making it very difficult to drive smoothly, and in some instances the RF may start hopping. Looking at these conditions from the perspective of the RF, as the track makes more bite, the RF is able to produce more grip. This extra grip causes more weight to transfer, the increased transfer increases vertical and lateral loads on the tire, and the larger loads (forces) cause the steering effort to increase. By running more negative camber in it we can use the camber to create turning force which reduces the amount of turning force we need from steer angle, thus resulting in lower steering efforts. Another thing that comes with more negative camber is that the stiffness of the RF will go down slightly and this will change the way that the tire's contact patch loads. This change will tend to slow the reaction of the tire to steer angle and load a bit which can make the kart a bit more driver friendly as this slower reaction time will tend to dampen out very small driver steer input imperfections. Finally, if the track is really biting hard and the RF camber is much lower than it needs to be then the outside corner of the tire can start to dip under which can cause several bad things to happen; the most obvious one being a hop. This type of RF hop comes from the corner digging under, letting loose, and then digging under again. So then, we add more negative RF camber to help the RF better match up to the amount of loading that it experiences to yield a more stable kart which is easier to drive.

The next thing about higher crossweights which tend to result in higher right front camber settings is that the higher cross weights simply add more load to the RF. This extra static load works in the same way that the increased bite of the track does which is to add bite to the RF. This increased bite has the same results as before, and thus we tend to do similar things to counter the extra load. Additionally, the extra RF load is accompanied by additional LR load. The higher negative RF camber can very slightly delay the reloading of the LR on exit which may lower a kart's tendency to push center off.

At this point we've better defined the reasons why we might add negative RF camber as we go from the lower cross range up to the higher but we haven't spoken at all about how much of one change comes with the other. This is a difficult thing to predict because of the differences in chassis design as we discussed earlier. On Generation 3 karts (which tended to be run with cross ranges in the high 60s and low 70s cross), as we go from the low 50s cross range to the high 60s and low 70s in going from a small, low grip track up to a larger, high grip track we might go from -2.75° up to -4°. On many of the Generation 4 karts which tend not to run such ultra-high cross numbers the change is typically smaller. On the small, low grip track we might run -2.5° and on the larger, high grip track we would run -3.25°. Although the ranges are different we see that the tendency to run more negative RF camber with more cross remains the same.

Now that we've described some of the main reasons we tend to run more negative camber in the RF, let's look at why we also may tend to run more positive camber in the LF. Before we dive in too deeply, we need to understand that the actual camber change we make as a result of a fairly large cross change may be very small, on the order of 1/4° to 1/2° or there may be no change made at all. As we discussed above, as we add cross we increase the load on the RF which can help a kart have more RF bite and more turning power; this extra turning power being most evident at turn-in because the RF is heavily loaded and weight is very quickly transferring to it. However, as the kart exits the corner the additional load that the cross increase added to the LR tends to become more prominent. What is actually happening is that as the kart exits the corner, the corner weight begins to transfer back to the LR from the right side and also a little will transfer from front to back as the kart accelerates off the corner. All this transfer to the LR causes it to plant hard, helping the RR produce grip and help drive the kart off the corner quickly – this is the main reason we tend to run the amount of cross we run in the first place. The problem is that all this LR bite increases the kart's tendency to be less responsive to steering input or be more pushy. If we recall from our previous discussions about RF camber, not only is the extra LR load reducing steering responsiveness center off, but we've also increased our negative RF camber which further decreases the steering responsiveness (even though we make this adjustment primarily to effect a change turn-in, it will also affect the turning power center-off as well). In order to counter these tendencies we need to put more turning power in the kart to help it turn as it needs to center off. The camber change we make to help add this necessary turning power is to run more positive LF camber which causes the LF dig into the track better allowing it to produce more turning power. We may also remember from our discussions on rear stagger, it is also not uncommon to run more rear stagger along with the ultra-high cross ranges to help the kart turn.

Hopefully at this point everyone better understands what cross tends to do to the RF and LR at turn-in and corner exit as well as what changes we tend to make in camber to better compliment the higher cross setups. We've also gone over the actual mechanisms which the higher cambers (negative on the RF, positive on the LF) used to change the handling characteristics of the kart. As a final comment, although we have looked only at the effects of running more cross or camber, as we would expect, running less cross would yield the opposite results. This is to say that as we go from the high cross range to the lower ranges we would expect to run a little less negative camber in the RF and a little less positive in the LF. One last comment: Even though the trend is to run more camber with more cross, this is not always the case so don't treat it as a hard, fast rule which must always be followed. In the end let the kart and laptimes tell you what it needs.

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